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The Madden-Julian Oscillation and its Teleconnections in a Warmer World

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Two simulations of the Superparameterized Community Earth System Model (SP-CESM) are examined, one with pre-industrial (PI) levels of CO_2 and one where CO_2 levels have been quadrupled (4xCO_2). While MJO convective variability increases considerably in the 4xCO_2 simulation, the dynamical response to this convective variability decreases. Increased MJO convective variability is shown to be a robust response to the steepening vertical moisture gradient, consistent with the findings of previous studies. The decreased dynamical response to MJO convective variability is shown to be a consequence of increased static stability, which allows weaker variations in large-scale vertical velocity to produce sufficient adiabatic cooling to balance variations in MJO convective heating. This weakened dynamical response results in a considerable reduction of the MJO's ability to influence the extratropics, which is closely tied to the strength of its associated divergence. A linear baroclinic model is used to verify the impact of increased static stability on the extratropical circulation in a warmer climate. Results of this study suggest that, while MJO convective variability may increase in a warming climate, the MJO's role in bridging weather and climate in the extratropics may not.